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DRAFT Southern California Association of Governments
Multi-Sector Catalog
Greenhouse Gas Reduction Policy Options

This catalog of Agriculture, Forestry and Waste Management regional-level greenhouse gas (GHG) reducing actions and policy options prepared by the Center for Climate Strategies (CCS) is based on actions undertaken or considered in state- and region-wide climate change action plans by multi-stakeholder groups in a wide cross-section of U.S. states and by state, local and private participants.

Sector 3 of 4: Agriculture, Forestry and Waste (AFW)

Table	Sector Covered
3	Agriculture, Forestry and Waste Management (AFW)

Key to Rankings* of Options in the Table that Follows:

Potential GHG Emission Reductions 1/	Potential Cost or Cost Savings [1, 2]
High (H): At least 1.0 million metric tons (MMt) carbon dioxide equivalent (CO_2e) per year by 2025	**High (H)**: $50 per metric ton CO_2e (tCO_2e) or above
Medium (M): From 0.1 to 1.0 $MMtCO_2e$ per year by 2025	**Medium (M):** $5 to 50/$tCO_2e$
Low (L): Less than 0.1 $MMtCO_2e$ per year by 2025, or 1 MMtCO2e by 2050	**Low (L):** Less than $5/$tCO_2e$
Uncertain (U): Not able to estimate at this time	**Uncertain (U):** Not able to estimate at this time
1 Several measures may overlap in terms of emissions reductions and/or cost impacts. Estimates assume measures would be implemented independently from other measures. 2 Costs are denoted by a positive number. Cost *savings* (i.e., "negative costs") are denoted by a negative number.	

*To be completed as part of the on-going process

The GHG reductions or cost/cost savings of some policy options are not quantified (NQ) due to lack of data or for other reasons.

Definition of "Priorities for Analysis*":

- **High:** High priority options will be analyzed first.
- **Medium:** Medium priority options will be analyzed next, time and resources permitting.
- **Low**: Low priority options will be analyzed last, time and resources permitting.

Important Note: The actions are numbered in this catalog solely for convenience in referencing them. Their numbers do NOT reflect a ranking or prioritization of the actions.

Table-3 Agriculture, Forestry, Waste Management (AFW)

This catalog will be developed more fully during the Energy Commerce and Resources Technical Work Group (TWG) process. TWG members are encouraged to provide input on policies and programs in place in Southern California to assist in defining baselines. The "Notes" column should be used to record recently enacted policies and programs in California relevant to policy options and management actions in the catalog.

Option No.	GHG Reduction Policy Option	Potential GHG Emission Reductions	Cost per Ton	Externalities, Feasibility Considerations	Priority for Analysis	Notes / Related Actions
AFW-1	**PRODUCTION OF FUELS AND ELECTRICITY IN AGRICULTURE AND FORESTRY**					
1.1	Expanded Use of Biomass Feedstocks for Electricity, Heat, and Steam Production			Need to identify viable feedstocks and volumes. Conventional and emerging/advanced technologies		CARB Scoping Plan
1.2	In-state Liquid Biofuels Production			• Production of biodiesel from both virgin and waste vegetable oils • Starch and cellulosic production processes for ethanol. Includes MSW as feedstock • Bio-oils from biomass		CARB Scoping Plan
1.3	Improved Energy Capture from Wood Waste and Biomass Combustion					
1.4	Improved Commercialization of Biomass Conversion Technologies					
1.5	Integrated Bioenergy Research and Production			Integrates electricity from anaerobic methane digestion of manure with biodiesel and ethanol production and by-products		
1.6	Expanded Production/Use of Bio-based Materials and Chemicals					

1.7	Installation of Manure Digesters			Costs dependent on livestock type and manure management methods		
1.8	Installation of Community Digesters					
AFW-2	**AGRICULTURE - LIVESTOCK**					
2.1	Manure Management – Manure Utilization as Soil Additive			Co-benefits include reduction of ammonia and VOC emissions. Incorporate into soil vs. surface application.		
2.2	Manure Management - Methane Capture from Manure			Reduce CH4 and N efficiency and downstream N_20. Co-benefit of reduced ammonia emissions.		
2.3	Manure Management - Biofilter use at Confined Animal Feeding Operations (CAFO)					
2.4	Manure Management - Lower Density Pasturing to Decrease Emissions from Manure					
2.5	Changes in Animal Feed to Optimize N_2O Reduction					
AFW-3	**AGRICULTURE – CROP PRODUCTION**					
3.1	Soil Carbon Management			Potential based on opportunities beyond current practice. Approaches include: conservation tillage, no-till; reduced fallow; increase winter cover; application of biochar		
3.2	Nutrient Management			Potential based on opportunities beyond current practice.		
3.3	Technology Improvements to Increase Efficiency			Improved soil sampling to optimize fertilizer application, improved machinery		

				systems, etc.		
3.4	Biotechnology Applications for GHG Mitigation			Improved research in and utilization of drought-resistant, flood-resistant, pest-resistant crop varieties, etc.		
3.5	Perennial Crop Production			Reduced planting, tillage, etc.		
3.6	Irrigation Improvements			Energy efficiency, conservation, conversion to diesel generators for pumping water		
3.7	Drainage Management			Reducing use of water through efficiencies & better management practices. Or draining excess water to increase plant growth.		
3.8	Improved Efficiency of Nitrogen Application Through Soil Sampling					
3.9	Improve Water Use Efficiency in Agricultural Production					CARB Scoping Plan
AFW-4	**AGRICULTURE AND OPEN SPACE – OPTIMIZATION OF LAND USE**					
4.1	Improve Vegetation on Marginal Lands			Reclamation with native vegetation; convert marginal agricultural lands to permanent cover; use biochar; use Conservation Reserve Program (CRP)		
4.2	Land Use Management that Promotes Permanent Cover			Need estimates of marginal ag land with the potential for conversion. Keep CRP lands in permanent cover. Increased demand for corn-based ethanol can incentivize converting grassland to crop production. (Relates to ethanol and biodiesel options.)		
4.3	Mine Land Reclamation			Regeneration for terrestrial		

				sequestration		
4.4	Preserve Agricultural Land			Reductions occur both from higher retention of carbon in soil and lower transportation activity.		
4.5	Preserve Open Space/Wildlands			Reduce the rate of land conversion to development		
4.6	Prioritize Environmental Remediation Actions for GHG Benefits			i.e., Re-vegetation of disturbed lands to improve carbon sequestration		
4.7	Preserve and Expand Wetlands for Carbon Sequestration			Anaerobic decomposition in unhealthy wetlands can increase GHG off-gassing.		
AFW-5	**AGRICULTURE – FARMING PRACTICES**					
5.1	Increase On-Farm Energy Production and Efficiency			Can include installing solar or wind power; hydro-powered generators for irrigation; converting diesel farm equipment to LNG/CNG or hybrid technology		CARB Scoping Plan
5.2	Organic Farming			Reductions occur via lower intensity ag practices (nutrient/ pesticide application, reduced tillage) & higher soil carbon		
5.3	Programs to Support Local Farming/Buy Local Programs			Locally-sourced foods for residential and institutional use.		
5.4	Promotion of Farming Practices that Achieve GHG Benefits			Community Gardens, Green Roofs. Need to be sensitive to greenbelt taxing issues.		
5.5	Increase use of Compost in Agriculture					CARB Scoping Plan

AFW-6	**RANGELAND MANAGEMENT**					
6.1	Improve Rangeland Management			Small per acre sequestration but significant acres available		
6.2	Drought Response			Would require moving or removing livestock from range. Use grass banks.		
6.3	Restoration of Degraded Rangelands					
6.4	Improve Grazing Crops and/or Management					
6.5	Mitigation of Carbon Sequestration Loss and Emissions from Rangeland Wildfires					
6.6	Increase Carbon Sequestration on Working Rangelands					CARB Scoping Plan
AFW-7	**FORESTRY – BIOMASS PROTECTION AND MANAGEMENT**					
7.1	Forest Protection – Reduced Clearing and Conversion to Non-Forest Cover			Reductions depend on current rates of clearing; Relatively large amount of carbon can be protected per acre		
7.1.1	No Net Loss of Forest, Agriculture or Range Lands			Mitigation of carbon losses from conversion		As articulated in AB 32 for forests – recommended by TWG member
7.2	Reforestation of Under-stocked Forest Lands			To achieve higher rates of carbon sequestration/ acre.		
7.3	Afforestation and/or Restoration of Non-Forested Lands			To achieve higher rates of carbon sequestration/ acre. Reductions depend on available land		
7.4	Sustainable Forest Management for Carbon Sequestration			Increased stocking of poorly stocked lands; Managed Stands: thinning & density management and age extension: Fertilization		CARB Scoping Plan

				and waste recycling; Expand short rotation woody crops (for fiber and energy); Expanded use of genetically-preferred species; Modified biomass removal practices; Reforestation.		
7.5	Mitigation of Forest Carbon Sequestration Loss and Emissions Due to Wildfire					CARB Scoping Plan
7.6	Improve Wildfire Surveillance and Monitoring					CARB Scoping Plan
7.7	Mitigation of Forest Loss Due to Insects and Disease					
7.8	Silvicultural and Technology Improvements			Improving techniques and technologies to save energy and water		
7.9	Wildlife Management to Encourage Vegetative Regeneration and Growth					
7.10	Vegetation Management to Increase Woody Matter and Succession					
7.11	Public Investment to Purchase Forests and Woodland					CARB Scoping Plan
AFW-8	**FORESTRY - WOOD PRODUCTS AND WASTE**					
8.1	Improved Mill Waste Recovery			Reductions depend on current levels of efficiency, which tend to be high		
8.2	Improved Logging and Other Residue Recovery			Reductions depend on energy recovery and current levels of efficiency (e.g., removal of insect damaged wood from managed areas)		
8.3	Expanded Use of New, Reused, and Recycled Wood Products			Cost depends on relative costs of materials; Expanded use of state and locally grown wood products for building materials. Reductions depend on		

				current wood product imports and potential for reducing transportation emissions.		
8.4	Promote In-State Forestry Products			Encouraging use of locally grown wood.		
8.5	Expanded Markets for Insect-Damaged Wood					
AFW-9	**WASTE MANAGEMENT – WASTE MANAGEMENT STRATEGIES**					
9.1	Advanced Recycling and Composting			Use waste oils as energy feedstocks.		
9.2	Expanded Use of Municipal Solid Waste and Yard Waste Biomass Feedstocks for Electricity, Heat, and Steam Production					
9.3	Promotion of Bioreactor Technology			Manage landfills to maximize methane generation over a short period of time.		
9.4	Source Reduction Strategies			Reduction of generation at the source reduces both landfill emissions as well as upstream production emissions		
9.5	Resource Management Contracting			Programs that compensate waste contractors based on performance in achieving waste reduction goals rather than the volume of waste disposed		
9.6	Waste Coal Recapture			Limited to states with waste coal resources. Emissions reduced relative to the mining of new coal.		
9.7	Prevent Landfilling of Unprocessed Organic Material			Reduces landfill methane by composting the biodegradable fraction of wastes. Often combined with advanced recycling.		
9.8	Waste Management Feedstocks for Liquid/Gaseous Fuels Production					

9.9	Increase Commercial Recycling					CARB scoping plan
9.10	Community Collection of Food Scraps for Composting and Anaerobic Digestion					CARB scoping plan
9.11	Establish System for Reuse or Recycling of Construction and Demolition Materials					ICLEI Climate Action Handbook
AFW-10	**WASTE MANAGEMENT – LANDFILL GAS STRATEGIES**					
10.1	Flare Landfill Methane at non-NSPS (smaller) Sites			Federal NSPS require methane capture at larger landfills. Need to consider energy required to collect CH_4.		
10.2	Methane & Biogas Energy Programs			Significant opportunities for digesters/energy utilization outside of the municipal solid waste sector		
10.3	Landfill Methane Energy Programs			Methane conversion to motor fuels (LNG), electricity, steam, or space heat are examples		
AFW-11	**WASTE MANAGEMENT – WASTEWATER MANAGEMENT ACTIVITIES**					
11.1	Energy Efficiency Improvements at Wastewater Treatment Facilities					
11.2	Lower Water Consumption to Lower Wastewater Processing Needs			Lower water consumption/ waste production lead to lower GHG emissions		
11.3	Install Digesters and Turbines, Engines or Fuel Cells			Reductions occur via methane control and offsetting fossil energy use		
11.4	Wastewater Treatment Plant Biosolids for Energy Production					
11.5	Algae in Waste Effluent for Biofuel Production			Algae may also be grown with flue gasses as source of carbon dioxide		
11.6	Utilization of Biosolids as a Fertilizer Substitute			May not be suitable for food crops. Public perceptions tend to be negative.		
11.7	Sequester Bio-solids and Brines					

	Underground; Capture Methane from in-situ Decomposition					
AFW-12	**URBAN FORESTRY AND URBAN AGRICULTURE**					
12.1	Increase Residential Tree Cover					ICLEI Climate Action Handbook
12.2	Increase Commercial/Municipal Tree Cover and Management			Cost savings possible if thinnings directed to products and energy		ICLEI Climate Action Handbook
12.3	Analysis of Tree Cover and Optimization of Tree Placement to Decrease Air Conditioning Needs					
12.4	Increase Greenspace Acreage			Including Green Roofs. Need to be sensitive to greenbelt taxing issues.		
12.5	Increase Carbon Sequestration in Parks and Greenspace through Improved Tree Stocking					
12.6	Promote Community Gardens					
12.7	Promote Local Agricultural Products through Farmer's Markets					
12.8	Protect Native Trees and Vegetation during Development					
12.9	Increase Use of Compost in Residential and Commercial Landscaping					
AFW-13	**WATER MANAGEMENT**					
5.1	Increase On-Farm Energy Production and Efficiency through Use of Hydro-powered Generators for Irrigation			Or converting diesel irrigation pumps to LNG/CNG or hybrid technology		CARB Scoping Plan *See also: AFW 5.1*
5.2	Weather-Based Irrigation Scheduling					CA Department of Water Resources' CA Irrigation Mgmt Information System (CIMIS) and CNMAFR
5.3	Regulated Deficit Irrigation			Used on drought-cycle tolerant crops. Improves crop quality while saving water		CNMAFR
5.4	Improved Irrigation Delivery Systems and Technologies			Versus water intensive flood systems		CNMAFR

5.5	Modernize On-Farm Water Infrastructure					CNMAFR

Acronyms

BGCC = Biomass Gasification Combined Cycle
CAFO = Confined Animal Feeding Operations
CARB = California Air Resources Board
GHG = Greenhouse Gas
ICLEI = International Council for Local Environmental Initiatives
N_2O = Nitrous Oxide
NSPS = New Source Performance Standards